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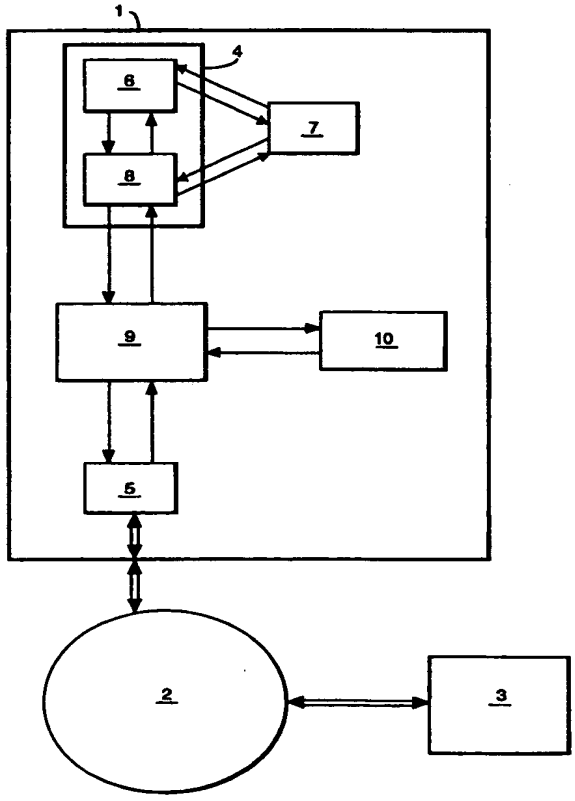
(54) Title: A COMMUNICATIONS NETWORK END STATION

(57) Abstract

The present invention relates to a communications network end station (1) which uses the Resource Reservation Protocol (RSVP) to reserve a quality of service, for communication with a second end station (3), over a communications network. The end station includes an interface (5) which connects a host processor (4) to the communication network and an RSVP signalling module (7) which is coupled to the host processor and which produces and processes resource reservation messages for reserving a quality of service determined by one of the end stations. Once generated, the resource reservation messages are transferred to the network via the host processor (4). A controller (9) is used to control the transfer of the data from the host processor (4) to the interface (5) so as to achieve the determined quality of service. The controller also transfers resource reservation messages between the interface and processor. An RSVP detector (10) is coupled to the controller (9) to detect resource reservation messages and determine from these messages the required quality of service. The detector then instructs the controller (9) to control the transfer of the data accordingly.



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A COMMUNICATIONS NETWORK END STATION

The present invention relates to a communications network end station utilizing the Resource Reservation Protocol (RSVP) to reserve a desired quality of service for communication with a second end station over a communications network utilizing a communications protocol.

RSVP is a protocol that may be used to reserve a desired quality of service for a specific data stream across a communications networks operating a communications protocol. The ability to specify a desired quality of service, which usually takes the form of specifying the minimum bandwidth required by the data or the maximum delay acceptable in the data transmission time, is particularly important in the transfer of real time data such as that used in multi-media, voice or video communications, or the like. The data which is to be sent with a desired quality of service is known as RSVP data.

The RSVP protocol is implemented by having the end station which is to transmit the data, generate a quality of service request in the form of a path message, which includes information concerning the type of data that is to be sent. This is done by a RSVP signalling module, which generates the path message in response to a request from an application that a specific quality of service be reserved. The path messages contain a filter and flow specification for the associated RSVP data stream.

Once generated by the RSVP signalling module, the path message is transferred via a protocol stack to a RSVP controller which passes the message to a network interface card driver to be transmitted onto the network. The path message is transferred through the communications network to one or more receiving end stations, visiting each node the network uses to carry the data. The receiving end station(s) receives the path message and analyses the flow and filter specification information to determine the quality of service that the receiving end station requires to satisfactorily use the RSVP data stream.

An indication of the required quality of service is then generated by the receiving end station in the form of an RESV message. This RESV message includes details of the filter and flow specifications of the RSVP data to be sent and is generated by a RSVP signalling module. From the RSVP signalling module the RESV message is transferred to the network in a similar manner to the path message generated in the transmitting end station. The RESV message is then returned through the communications network, on the same path along which the path message was sent, attempting to make a reservation at each node.

At this stage, each node along the path indicates whether it is able to allocate the necessary resources required for transferring the data with the desired quality of service. If there is a path through the network which is capable of achieving the desired quality of service, the RESV packet is returned to the transmitting end station, indicating a path has been reserved.

On receipt of the RESV message by the transmitting end station the RESV message is passed from the network interface card to the RSVP signalling module typically via an IP protocol stack. The RSVP signalling module will confirm that the path has been reserved. At this point the application will, if it has not already done so, begin transmitting the RSVP data. The RSVP signalling module will set parameters in the RSVP controller to enable the controller to control the transmission of the associated RSVP data from the end station to the network to ensure that it receives the required quality of service as it passes through the network. This is achieved by delaying the transfer of non-RSVP data and transferring RSVP data instead, ensuring the desired quality of service may be maintained for the transfer of RSVP data.

This is standard RSVP implementation, a more detailed description can be found in IETF RSVP specifications such as DRAFT-IETF-RSVP-SPEC-14.TXT, dated November 1996.

Currently however the system suffers from the drawback that there needs to be a direct interface between the RSVP signalling module and the RSVP controller to ensure that the quality of service is established on the interface between the end station and the network. With the current level of system modularity it is not always possible to establish this direct interface.

In accordance with a first aspect of the present invention, we provide a communications network end station utilizing the Resource Reservation Protocol to reserve a quality of service, for communication with a second end station, over a communications network utilizing a communications protocol, the end station comprising; a host processor; an interface for connecting the host processor to the communication network; an RSVP signalling module coupled to the host processor which produces and processes resource reservation messages for reserving a quality of service determined by one of the end stations, wherein the resource reservation messages are transferred to the network via the host processor; a controller coupled to the host processor and the interface, wherein the controller controls the transfer of the data from the host processor to the interface in accordance with the determined quality of service and transfers resource reservation messages between the interface and processor; and an RSVP detector coupled to the controller, wherein the RSVP detector detects resource reservation messages and determines from the messages the determined quality of service and instructs the controller to control the transfer of the data accordingly.

In accordance with a second aspect of the present invention, we provide a method of operating a communications network end station utilizing the Resource Reservation Protocol to reserve a quality of service, for communication with a second end station, over a communications network utilizing a communications protocol, the end station having a host processor, an interface for

connecting the host processor to the communication network, the method comprising producing and processing resource reservation messages for reserving a quality of service determined by one of the end stations; transferring the resource reservation messages to the network via the host processor; generating the data for transmission; detecting the resource reservation messages to determine the reserved quality of service and controlling the transfer of the data to the interface in accordance with the determined quality of service.

We have designed a communications network end station and a method of operating the end station in accordance with the RSVP protocol that allows a desired quality of service to be attained between the end station and the network without requiring a direct interface between the RSVP signalling module and the RSVP controller.

The network end station utilizes a detector which detects the resource reservation messages as they are passed between the host processor and the network interface. As a consequence, the detector is able to determine the quality of service that has been reserved between the two end stations. The detector then instructs a controller, which is used to transfer data from the host processor to the interface, to transfer the data from the host processor in accordance with the quality of service that has been reserved. This prevents the need for a direct interface between the RSVP signalling module and either the controller or the detector. This greatly improves the ability of current apparatus to be modified to allow a desired quality of service to be attained between the communications network end station and the communications network.

Typically the transfer of the data is controlled by modifying the data to indicate that the data requires a determined quality of service. This can be used, for example, if the communications protocol utilises different priorities for different sets of data. Modifying the data

by increasing the priority means that the data will be transmitted in preference to lower priority data, thus ensuring the desired quality of service.

Alternatively, the transfer of the data is controlled by delaying the transfer of data not to be transferred with a determined quality of service. Often the processor will be generating data that is not to be transferred with a determined quality of service as well as the data that is to be transferred with the determined quality of service. Accordingly, by delaying the transfer of the former data, the desired quality of service can be ensure for the quality of service data.

Typically the end station further comprises an adaptor coupled to the host processor and the RSVP signalling module, wherein the adaptor modifies data received from the host processor to comply with the communications protocol. Alternatively however, the processor may output the data in the form required by the network, in which case no modification is required.

An examples of the present invention will now be described with reference to the accompanying drawing, in which:-

Figure 1 shows in schematic form an example of a network end station according to the present invention.

Figure 1 shows an end station 1 coupled to a communications network 2 such as the Internet. Also coupled to the network 2 is a second end station 3 which is of a similar design to end station 1 so as to allow RSVP type communication to be carried out between the two end stations 1, 3.

The end station 1 has a processor 4 which is connected to the network 2 via a network interface card 5. The processor 4 includes an application 6, such as a voice or video communications programme, which will either generate or transfer in from an external source, data suitable for transfer over the communications network 2, to the end station 3. The application 6 is coupled to an adapter 8,

such as an IP protocol stack, and a RSVP signalling module 7. The adapter 8 is also connected to the RSVP signalling module 7 and an RSVP controller 9. The RSVP controller 9 is connected to a RSVP detector 10 and the network interface card 5.

In use, the data generated by the application 6 is transferred to the adaptor 8. This operates to alter the format of the data so that it is suitable for transmission over the network 2 in accordance with the communications protocol operated by the network as is well known to a skilled person in the art. In the case of RSVP communications, the network will usually be operating IPV4 or IPV6 protocols.

The data is then transferred via the controller 9 to the network card 5 and subsequently on to the network 2. From here the data is transferred across the network 2 to the end station 3 in the usual manner.

In order to reserve a specific quality of service for a given data stream from the end station 1, across the communication network 2, to the end station 3, it is necessary for the end station 1 to generate commands requesting that a reservation be made. This is done by the RSVP signalling module 7, which generates the commands in response to a request from the application 6 that a path be reserved.

The commands generated by the RSVP signalling module 7 take the form of a path message and an RESV message. The path message is, in general, a single data packet containing information including a filter specification and a flow specification. The filter specification is a set of features of the RSVP data, such as the source and destination addresses, whilst the flow specification describes characteristics of the RSVP data flow, such as the number of packets per second that will be transmitted. This information allows the network 2 and the end stations 1, 3 to identify which data is from the application 6 and

therefore which data is to have reserved a specific quality of service.

Once generated by the RSVP signalling module 7, the path message is transferred to the adaptor 8, where any required headers are added to the message, then via the controller 9 and the network interface card 5 to the network 2. The RSVP detector 10 monitors the path messages as they pass through the controller 9.

Once transferred to the network 2, the path data is carried through the network and modified at each node visited to record the path used. This is standard RSVP protocol operation which will be understood by a person skilled in the art.

From the network 2, the path message is transferred to the end station 3. Here the headers are removed from the message before the filter and flow specification information is analyzed to determine the quality of service required by the end station 3. This depends on the bandwidth etc. that the end station 3 will require the RSVP data to be transferred at so as to allow successful handling of the data.

An indication of the required quality of service is then generated in the form of an RESV message. This RESV message is a data packet which again includes details of the filter and flow specifications of the RSVP data to be sent. The RESV data is generated by the RSVP signalling module of the end station 3 and transferred to the network 2 in a similar manner to the path message generated in the end station 2.

The RESV message is returned along the same path through the communications network 2 that the path message travelled along. At each node in the network, an attempt is made to reserve sufficient node resources to achieve the desired quality of service for the transmission. Should the reservation be successful, the RESV message is updated and transferred to the next node. This continues until the

RESV message is received by the network interface card 5 of the end station 1.

Should the resource allocation be unsuccessful at any stage, an error message is returned to the end station 3 indicating that there are insufficient resources available at this time.

The RESV message is then passed from the network interface card 5 through the controller 9 to the adaptor 8, where any headers required for transfer over the networks 2 are removed before the data is transferred to the RSVP signalling module 7. The RSVP signalling module 7 will confirm that the path has been reserved and instruct the application 6 to begin transmitting the RSVP data.

The RSVP detector 10 monitors and analyses all path and RESV messages that are transferred through the controller 9 to determine when a quality of service has been reserved and what the allowable quality of service is. The RSVP detector 10 then instructs the controller 9 to ensure that the RSVP data is sent in accordance with this specified quality of service.

This may be achieved in one of two manners. Firstly, it may be necessary for the controller 9 to modify the RSVP data before it is transferred to the network interface path 5.

For example, in a token ring network a token ring frame can have one of eight priority levels. If a real time application requests that its associated data should be handled as high priority data the RSVP detector 10 will examine the relevant path and RESV messages and instruct the controller 9 to modify the token ring header priority field to a relevant priority prior to passing the data frame to the network interface card 5 to be passed onto the network 2.

Alternatively, however, it may be that the host processor is also generating data not to be transferred in accordance with the RSVP protocol. This non-RSVP data may use up bandwidth that the RSVP data requires. In this

circumstance, the RSVP controller 9 will delay the transfer of the non-RSVP data to the network interface card 5, thus allowing the RSVP data to be transferred with the desired quality of service.

The RSVP detector 10 may also control the modification or replacement of RSVP messages. For example if the requested bandwidth can not be supported over the first hop, i.e. the connection between the end station and the first router, the RSVP detector 10 will modify or replace the RESV message to indicate to the network that the specified quality of service can not be supported.

CLAIMS

1. A communications network end station utilizing the Resource Reservation Protocol to reserve a quality of service, for communication with a second end station, over a communications network utilizing a communications protocol, the end station comprising; a host processor; an interface for connecting the host processor to the communication network; an RSVP signalling module coupled to the host processor which produces and processes resource reservation messages for reserving a quality of service determined by one of the end stations, wherein the resource reservation messages are transferred to the network via the host processor; a controller coupled to the host processor and the interface, wherein the controller controls the transfer of the data from the host processor to the interface in accordance with the determined quality of service and transfers resource reservation messages between the interface and processor; and an RSVP detector coupled to the controller, wherein the RSVP detector detects resource reservation messages and determines from the messages the determined quality of service and instructs the controller to control the transfer of the data accordingly.

2. A communications network end station according to claim 1, wherein the controller controls the transfer of the data by modifying the data to indicate that the data requires the determined quality of service.

3. A communications network end station according to claim 1, wherein the controller controls the transfer of the data by delaying the transfer of data not to be transferred with the determined quality of service.

4. A communications network end station according to any of the preceding claims, further comprising an adaptor coupled to the host processor and the RSVP signalling module, wherein the adaptor modifies data received from the host processor to comply with the communications protocol.

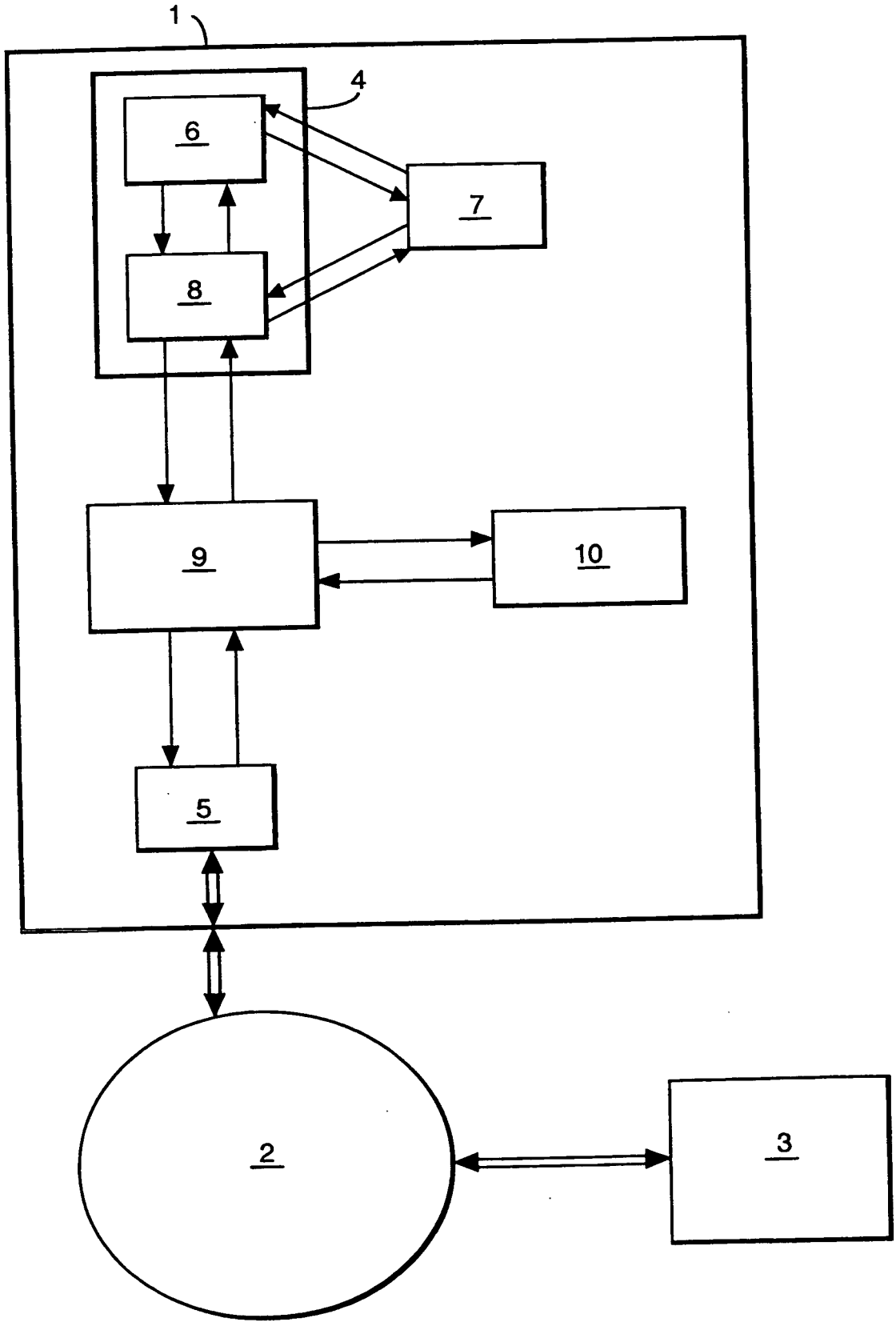
5. A method of operating a communications network end station utilizing the Resource Reservation Protocol to reserve a quality of service, for communication with a second end station, over a communications network utilizing a communications protocol, the end station having a host processor, an interface for connecting the host processor to the communication network, the method comprising producing and processing resource reservation messages for reserving a quality of service determined by one of the end stations; transferring the resource reservation messages to the network via the host processor; generating the data for transmission; detecting the resource reservation messages to determine the reserved quality of service and controlling the transfer of the data to the interface in accordance with the determined quality of service.

6. A method according to claim 5, wherein the transfer of the data is controlled by modifying the data to indicate that the data requires the determined quality of service.

7. A method according to claim 5, wherein the transfer of the data is controlled by delaying the transfer of data not to be transferred with the determined quality of service.

8. A method according to any of claims 5 to 7, further comprising modifying the data to comply with the communications protocol.

Fig.1.



INTERNATIONAL SEARCH REPORT

Inter .onal Application No
PCT/GB 99/00460

A. CLASSIFICATION OF SUBJECT MATTER
IPC 6 H04L12/56 H04L29/06

According to International Patent Classification (IPC) or to both national classification and IPC

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)
IPC 6 H04L

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

Electronic data base consulted during the international search (name of data base and, where practical, search terms used)

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category °	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
A	BARZILAI T ET AL: "DESIGN AND IMPLEMENTATION OF AN RSVP-BASED QUALITY OF SERVICE ARCHITECTURE FOR INTEGRATED SERVICES INTERNET" PROCEEDINGS OF THE 17TH. INTERNATIONAL CONFERENCE ON DISTRIBUTED COMPUTING SYSTEMS, BALTIMORE, MD., MAY 27 - 30, 1997,27 May 1997, pages 543-551, XP000793049 INSTITUTE OF ELECTRICAL AND ELECTRONICS ENGINEERS see page 545, right-hand column, line 16 - page 547, right-hand column, line 8 --- -/--	1-8

[X] Further documents are listed in the continuation of box C.

[ ] Patent family members are listed in annex.

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INTERNATIONAL SEARCH REPORT

Inte .onal Application No
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C.(Continuation) DOCUMENTS CONSIDERED TO BE RELEVANT

Category °	Citation of document, with indication,where appropriate, of the relevant passages	Relevant to claim No.
A	ENGEL R ET AL: "Exploring the performance impact of QoS support in TCP/IP protocol stacks" PROCEEDINGS. IEEE INFOCOM '98, THE CONFERENCE ON COMPUTER COMMUNICATIONS. SEVENTEENTH ANNUAL JOINT CONFERENCE OF THE IEEE COMPUTER AND COMMUNICATIONS SOCIETIES. GATEWAY TO THE 21ST CENTURY (CAT. NO.98CH36169), PROCEEDINGS IEEE INFOCOM'98 CONFERENCE O, pages 883-892 vol.2, XP002108135 ISBN 0-7803-4383-2, 1998, New York, NY, USA, IEEE, USA see page 884, right-hand column, line 10 - page 885, right-hand column, line 25 ---	1-8
P,A	CHOW H K ET AL: "Implementation and performance evaluation of ISAC: integrated services Internet with RSVP over ATM shortcuts" ICC '98. 1998 IEEE INTERNATIONAL CONFERENCE ON COMMUNICATIONS. CONFERENCE RECORD. AFFILIATED WITH SUPERCOMM'98 (CAT. NO.98CH36220), ICC '98 1998 IEEE INTERNATIONAL CONFERENCE ON COMMUNICATIONS. CONFERENCE RECORD, ATLANTA, GA, USA, 7-11 JUNE 1998, pages 1219-1225 vol.2, XP002108136 ISBN 0-7803-4788-9, 1998, New York, NY, USA, IEEE, USA see page 1220, left-hand column, line 35 - page 1221, left-hand column, line 12 -----	1-8

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